SELCO

B 6095 - 13

# Generator Protection System B 6000 and Generator Trip Indicator B 6900

## Introduction

SELCO Generator protection system B6000 is a second generation, designed for protection of parallel working AC generators. Besides reverse power and overload protection this system also includes short circuit protection. Optionally the system can be equipped with frequency detection. Furthermore the relay can be provided with two extra overcurrent/time units which can be used for alarms and/or tripping of non-essential load. It is also possible to obtain normally energized or normally de-energized output relay functions for each of the output relays.

Measurements are made in the electronic circuits, but the output signals are given through electro-mechanical relays.

The electronic measuring circuits as well as the output relays (max. 3) corresponding to the number of alarm and tripping units have been designed as plug-in units in order to take into account the number of relay functions required.

In order to increase the security the units have been separated as regards to function and circuits having the effect that if a unit fails, it can be removed without influencing the remaining functions.

Relay equipment used in connection with generator protection against short circuit, reverse power, and overcurrent does not usually indicate the cause of the actual fault and consequently, SELCO has developed an indicator, Generator Trip Indicator B 6900, capable of indicating which of the three protection units has tripped the generator breaker.


Fig. 1.


Fig. 2.

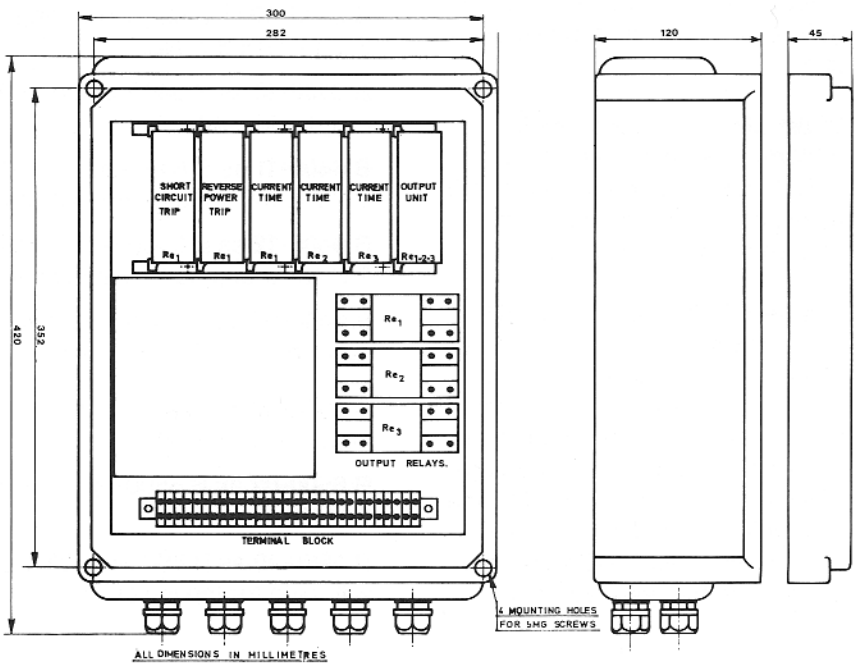



Fig. 3

# Generator Protection System B 6000 and Generator Trip Indicator B 6900

## Description

Generator Relay B 6000 consists of the following plug-in units:
Short Circuit Unit B 6100
Short Circuit Unit B 6600-10
Reverse Power Unit B 6200-20
Overcurrent/Time Unit
B 6300-10/11/14/15/16/17/18
Normally De-energized Output Unit
B 6400-00/01/11/12/30
Normally Energized Output Unit
B 6500-00/02/10/11/12
Frequency Relay B 6800-00

all of which are electronic circuits and which combined with 4 current transformers with $I_{max}$ logic circuit, power supply and 3 output relays constitutes a complete generator relay.

**Short Circuit Unit B 6100**
measures by means of the $I_{max}$ logic circuit the peak value of the maximum current in the three phases.
If the current exceeds the preset value (2-10 × $I_N$) the output relay is activated and the generator will immediately be tripped. The unit is independent of the system voltage as it is supplied from the measuring current.

**Short Circuit Unit B 6600-10**
performs the same function as B 6100 but has been provided with a time delay function adjustable between 0.03 and 3 secs.

**Reverse Power Unit B 6200-20**
compares the current of one phase to the voltage between two other phases thus determining I × cosφ. If this value becomes negative and higher than the preset percentage of the nominal current (1-10%) the time unit is started. If the preset time is exceeded (1-10 secs.) the unit will trip the generator by means of the output relay. The time unit is reset as soon as I × cosφ is less negative than the preset value.

**Current/Timer Unit B 6300-10** is via the $I_{max}$ logic circuit supplied with the actual peak value of the three phase currents. If the preset value (0.5-2.0 × $I_N$) is exceeded the time unit is activated. When the preset time has expired (0.3-30 secs.) either the non-essential part of the load or the generator will be tripped by means of the output relay. In case of current drop below the preset value, the time unit will immediately be reset.

**B 6300-11** as B 6300-10 but 0,5 – 2 × $I_N$ – Time delay 0,9 - 90 sec.

**B 6300-14** as B 6300-10 but 2 – 10 × $I_N$ – Time delay 0,3 - 3 sec.

**B 6300-15/16** as B 6300-10 but including voltage monitoring.

**B 6300-17** as B 6300-10 but 0,25 – 1,0 × $I_N$ – Time delay 0,3 – 3 sec.

**B 6300-18** as B 6300-10 but 0,5 – 2 × $I_N$ – Time delay 1,2 – 120 sec.

**B 6400-00** Normally De-energized Output Unit 3 × ND

**B 6400-10** as B 6400-00 but with plug for trip indicator

**B 6400-11** as B 6400-00; 2 × ND, 1 × NE with plug for trip indicator

**B 6400-12** as B 6400-00; 1 × ND, 2 × NE with plug for trip indicator

**B 6400-30** as B 6400-00 but to be applied when B 6800 is applied.

**B 6500-00** Normally Energized Output Unit 3 × NE

**B 6500-02** as B 6500-00; 1 × NE, 2 × ND

**B 6500-10** as B 6500-00; 3× NE with plug for trip indicator

**B 6500-11** as B 6500-00 2 × NE, 1 × ND with plug for trip indicator

**B 6500-12** as B 6500-00 1 × NE, 2 × ND with plug for trip indicator.

Output for trip signal can be obtained by
1. Trip indicator B 6900 + cable B 6902 or
2. Cable B 6701 to central alarm system.

**Frequency Relay B 6800-00:**
To obtain frequency detection as a function of generator protection, the frequency relay B 6800 can be inserted in the fifth position (to the left of the output unit) in generator protection relay B 6000.
A special output unit, with 30 added to the index, is necessary to control the signals from the frequency relay to the output relays. All functions in existing output units can be supplied except for normally energized output relays connected to terminals 22 and 27. The upper frequency dial on the relay unit has the lowest setting because it will, after its appropriate delay, operate the output relay for tripping the circuit breaker (terminals 10 to 15). The lower frequency dial on the relay unit has the highest setting and will, after its appropiate shorter delay, operate the output relay for tripping the non essential load (terminals 22 to 27).

The operation is as follows:
Should the frequency drop below the first level due to overload or other faults, then the non essential load will trip after a relatively short delay to deload the generator. Should the frequency drop below the second level which must be set with a relatively longer delay, the generator circuit breaker will trip.

Frequency setting: 45 – 65 Hz
Time delay setting: 0 – 10 sec.

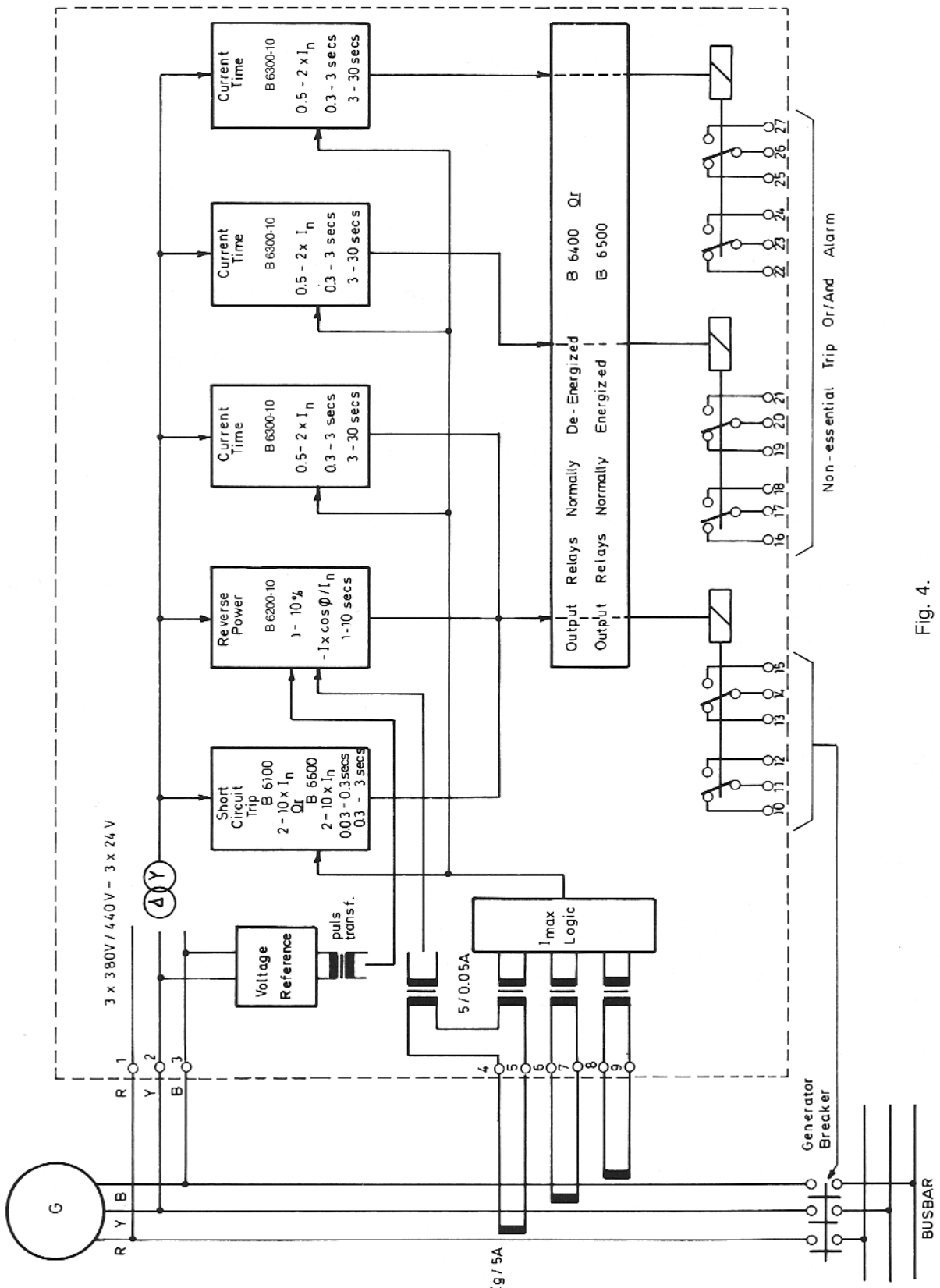

Current Time
B 6300-10
0.5 - 2 x In
0.3 - 3 secs
3 - 30 secs
Reverse Power
B 6200-10
1 - 10 %
- 1 x cos ø / In
1-10 secs
Short Circuit Trip
B 6100
2 - 10 x In
Or
B 6600
2 - 10 x In
0.03 - 0.3 secs
0.3 - 3 secs
Output Relays Normally De-Energized
Output Relays Normally Energized
B 6400 Or
B 6500
Non-essential Trip Or/And Alarm
3 x 380V / 440V - 3 x 24 V
Voltage Reference
puls transf.
Imax Logic
5 / 0.05A
Ig / 5A
Generator Breaker
BUSBAR
G
R
Y
B

Fig. 4.

# Generator Protection System B 6000 and Generator Trip Indicator B 6900

## Technical Data: Generator Relay B 6000:

| | |
|---|---|
| Supply Voltage: | $U_N = 3 \times 380V$ or $3 \times 440V$ other voltages up to $3 \times 660V$ on request |
| Frequency Range: | 30 to 70 Hz |
| Current Supply: | 3 phase currents $I_N \times 5A$, load $3 \times 2.5VA$ at $I_N$ |
| Voltage Range: | 50-110% of $U_N$, load $3 \times 5VA$ |
| Output Relays: | 2 change-over contacts 30V/2A DC or 440V/2A AC |
| Short Circuit Setting Range: | 2-10 $\times I_N$ continuously variable, independent of supply voltage |
| Short Circuit time Setting: (B 6600-10 only) | 0.03-0.3 secs. or 0.3-3.0 secs. continuously variable within each range selectable by means of a change-over switch. Overshoot: 15 ms. |
| Reverse Current Component I cosφ: | 1-10% of $I_N$, continuously variable, independent of supply voltage |
| Time Delay for Reverse Power Unit: | 1-10 secs., continuously variable, independent of supply voltage |
| Overcurrent Setting Range: | 0.5-2.0 $\times I_N$, continuously variable, independent of supply voltage |
| Time Delay for Overcurrent: | 0.3-3.0 secs. or 3.0-30 secs., continuously variable within each range selectable by means of a change-over switch, independent of supply voltage. Overshoot: 15 ms. |
| Accuracy of all Settings: | ±5% of highest possible setting |
| Temperature Range: | −20°C to +70°C ambient temperature |
| Enclosure: | Insulating glassfibre reinforced polyester case with polycarbonate cover |
| Overall Dimensions: | 420 × 300 × 175 mm |
| Weight: | Approx. 11 kgs |

## Example of Scale Settings:

All relay settings refer to the primary side of the main current transformer, e.g. 800A (800/5A).

### Short Circuit:

Current Transformer: 800/5A
Rated Generator Current: 695A
Required Tripping Level: $5 \times I_G = 5 \times 695A$
Scale Setting: $\frac{5 \times 695}{800} = 4.3$

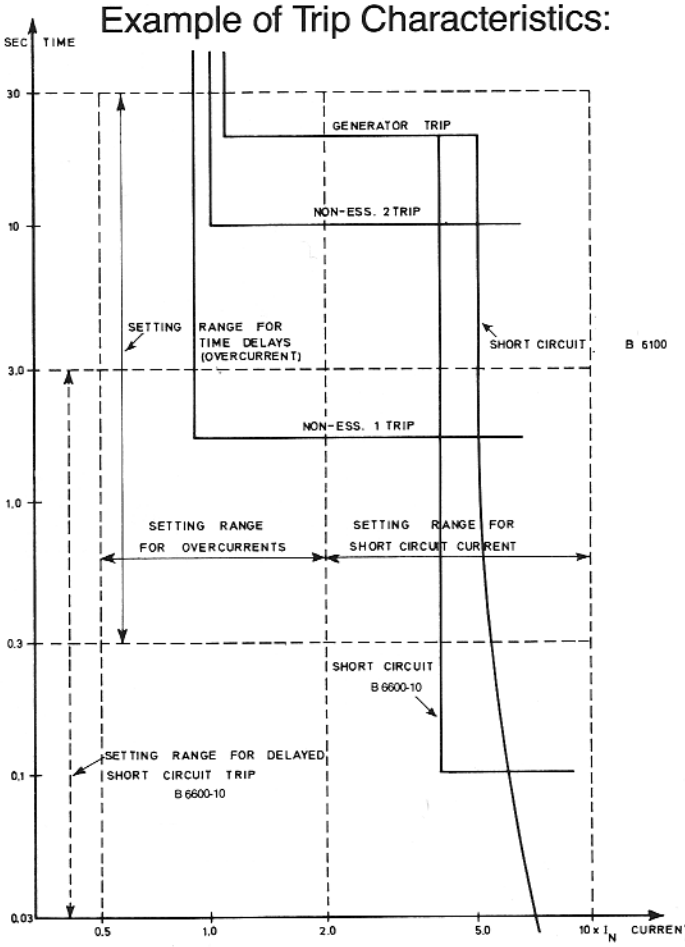
### Reverse Power:

Generator Rating: $3 \times 450V$, 540kVA, 695A. Assuming $\cos \varphi = 0.8$ the generator is capable of delivering $540 \times 0.8 = 432kW$ corresponding to $I_W = 555A$. The scale corresponds to 100% $= \sqrt{3} \times 450 \times 800 = 625kW$, $I_W = 800A$.
Required Tripping Level: 6% of $P_G$
Scale Setting: $\frac{6 \times 555}{800} = 4.2\%$

### Overcurrent:

Current Transformer: 800/5A, i.e. 1.0 on the scale = 800A
Generator Rating: 695A
Required Tripping Level: $1.1 \times I_G = 1.1 \times 695A$
Scale Setting: $\frac{1.1 \times 695}{800} = 0.96$

## Example of Trip Characteristics:




SETTINGS: NON-ESSENTIAL 1 : 0.9 x $I_N$, 2 secs
NON-ESSENTIAL 2 : 1.0 x $I_N$, 10 secs
GENERATOR : 1.1 x $I_N$, 20 secs
B 6100 SHORT-CIRCUIT : 5.0 x $I_N$
OR B 6600-10 SHORT-CIRCUIT : 4.0 x $I_N$, 0.1 secs

Fig. 5.

# Generator Protection System B 6000 and Generator Trip Indicator B 6900

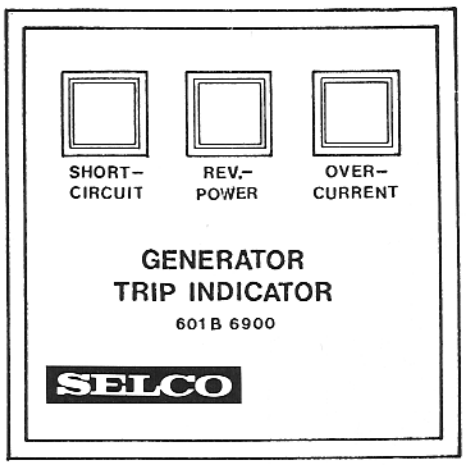



Fig. 6. Front panel

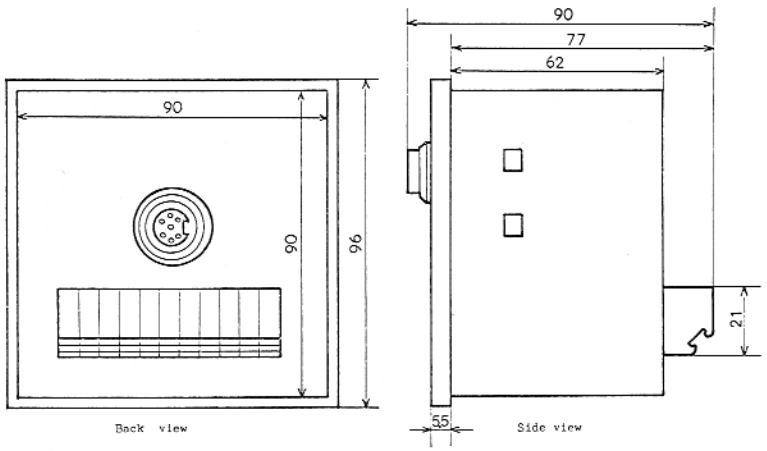



Fig. 7. Dimensions in mm

**Generator Trip Indicator B 6900** has been provided with 3 lighted pushbuttons, one for each of the 3 trip signals to the generator breaker: short circuit, reverse power, and overcurrent.
The external generator trip indicator is connected to the generator relay by means of a multicore cable and a corresponding DIN plug. Standard watertight screwed glands are used for cable entries.

When the generator breaker has been tripped because one of the protective limits have been exceeded, outputs from the generator relay will lit the relevant indicator pushbutton (short circuit, reverse power, or overcurrent).
The fault will remain indicated until the pushbutton has been pressed even if the fault has been rectified and the generator breaker has been reclosed.

The indicator has been provided with a change-over contact for each of the 3 functions which can be used to prevent the generator from being reclosed before the lighting pushbutton of the indicator has been pressed.
Terminals 10 and 11 are connected to 24V DC, voltage is supplied from busbar, accumulator, etc. depending on reliability requirements.

## Cable B 6701

When using cable B 6701, the generator relay must be equipped with the same output units as for the trip indicator:
B 6400-10, B 6500-10, and
B 6500-12.

Output cable for trip signal with marked terminals as follows:

1. Common
2. Overcurrent trip signal
3. Reverse power trip signal
4. Short circuit trip signal

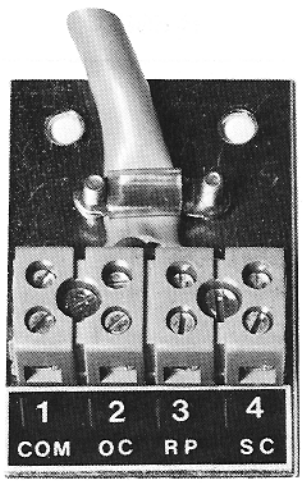
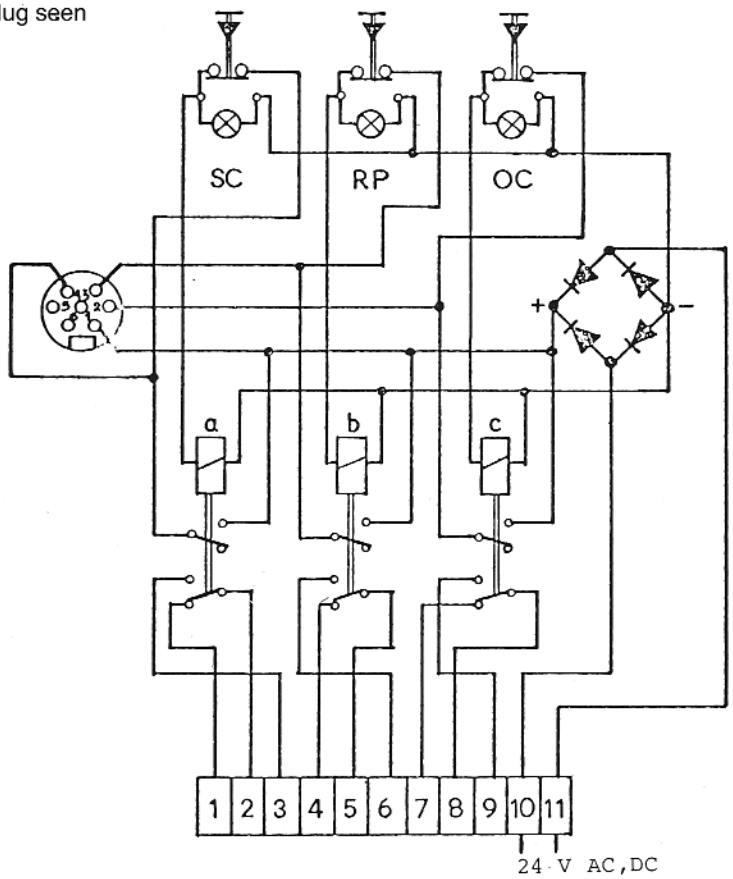



Fig. 8

Fig. 9. Terminals and DIN-plug seen from connection side




## B 6900

### Technical Data:

### Generator Trip Indicator:

| | |
|---|---|
| Operating Voltage: (terminals 10 and 11) | 24V DC/AC |
| Connection to Output Units: | B 6400-10/11/12<br>B 6500-10/11/12 |
| Terminal Connections: | See figure 9 |
| Output Contacts open/close: | 220V ~ 4A AC |
| Dimensions: | See figure 7 |
| Weight without Cable: | 460 grammes |
| Weight incl. 3 m Cable fitted: | 820 grammes |
| Interconnection Cable Specify: | B 6902 |

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